[Second Edition.]

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COMPLETE SPECIFICATION

Improved Methods of Making Porous Metal Plates and Apparatus therefor.

We, GENERAL MOTORS CORPORATION, a Company incorporated under the laws of the State of Delaware, in the United States of America, of Grand Boulevard, in the City of Detroit, State of Michigan, in the United States of America (Assignees of RICHARD G. OLT and EARL W. REINSCH, citizens of the United States of America), do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement :—

This invention relates to methods of making porous metal plates and apparatus therefor by moulding metal powder in a substantially non-compacted condition.

The basis of the invention is to utilise centrifugal force to fill an enclosed mould cavity working progressively from the outer periphery to the centre.

This is of particular utility in the making of a plate whose cross-section is irregular, for example, of wave-like form.

The apparatus comprises a mould with members which can be fastened together to form the required enclosed cavity and one of which has an aperture at the centre for filling the cavity, the mould having means by which it can be attached to a rotatable support.

Further features of the invention will be apparent from the following description with reference to the accompanying drawings, of how it can be carried into effect.

In the drawings :

Figure 1 is a plan view of the many types of porous metal plates which may be made by the method of this invention ;

Figure 2 is a section on the line 2—2 of Figure 1 ;

Figure 3 is a diagrammatic view of the apparatus for forming a plate as shown in Figure 1 ;

Figure 4 is a plan in reduced size of the mould used in the apparatus shown in Figure 3, particularly showing the pins which position the two portions of the mould.

Metal powders when sintered in a substantially loose, non-compacted condition, that is to say non-briquetted powders form highly porous metal members.

Heretofore it has been found impossible to form loose, non-compacted powders into a plate form wherein the plate has an irregular formation on the surface thereof. This is explained by the fact that it is impossible to spread metal powders manually to a uniform thickness over an irregular mould surface. One such plate 20 is shown in Figure 1, and it is formed with a plurality of concentric rings 22 which give it a wave-like cross-section. Plates of this character are often used as filtering media in filters where a large surface area is desired and where the space is limited. Heretofore such plates had to be formed by punch press operation after manufacture of the sintered plate in a flat condition. This operation, however, caused a compacting of the porous metal at certain portions of the plate and thereby made the plate undesirable for its intended use.

The basis of the present invention is that such plates can be moulded by centrifugal distribution methods. In the illustrated example a mould made of graphite, oxidised chrome steel or the like, or steel dusted with some powder, such as graphite or alundum is used. Such a mould is separable into two portions each of which carries a complementary portion to form the desired moulded cavity. The mould 24 in Figure 3 has a mould cavity and includes an upper member 28 and a lower member 30. The two members are keyed together as at 32 and may also include positioning pins 33 (Figure 4) if desired. The mould 24 has a central aperture 34 for filling purposes. Lower member 30 has positioning holes 36 at its central portion which are adapted to fit over pins on a turn-table 38 carried and driven by an electric motor 40.

In operation, the mould is rotated by the motor and metal powder is supplied through a funnel 42 into the central aperture 34. The powder is filled in slowly and as it comes into contact with the walls of the mould cavity it is distributed centrifugally and thereby fills the mould, first

at its outer periphery and gradually to the centre. The metal powder is thus substantially non-compacted and fills every portion of the mould cavity regardless of its irregular cross-section. After the motor 40 has stopped the mould 24 is removed and placed in a furnace under suitable non-oxidising conditions for a time and at a temperature sufficient to cause the metal powder to sinter together in a strong metal member. The mould members are then separated and the sintered plate is removed.

The plate may be made from any of the usual metal powders in accordance with its desired use. It is apparent from the above description that the method is easy to carry out, and that it forms porous metal objects of substantially uniform density therethrough since the only difference in density is caused by the difference in centrifugal force at different portions of the mould. It is preferable to rotate the mould at relatively low speed so that this difference is not appreciable. For example, a motor rotating at 1750 r.p.m. gives successful results. However, a motor rotating at 100 r.p.m. and above will yield desired results.

It is manifest likewise that by using a high speed motor, a density may be obtained which varies from the periphery to the centre of the piece: if desired speeds of the order of 10,000 r.p.m. and upward may be used. In this manner, a plate is formed having gradually decreasing porosity from the centre outwards. It may be desirable to make flat plates by this method since it is impossible to compact metal powder differentially in a mould by any other method.

In many instances, for example when there is a corrugated surface on the circular article, it is advisable to provide for a vertical or axial vibration, to aid the particles of metal in going over the peaks and trough of the mould. Although this is not always necessary, it helps to distribute the powder. Such motion need only be of small amplitude and can be caused for example by solenoid action or by a cam.

While the above described embodiment of the present invention constitutes a preferred form, it is to be understood that other forms might be adopted, within the scope of the appended claims.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. The method of making porous metal plates comprising supplying metal powder at the centre of the cavity in an enclosed mould which is rotating at a speed sufficient to cause the powder to be thrown outwardly so as progressively to fill the mould cavity working from the outer periphery to the centre, and then sintering the metal powder within the mould under suitable conditions of time, temperature and atmosphere to cause the metal particles to form a rigid plate.

2. The method of making porous metal plates of irregular cross-section, such as wave-like form, comprising supplying metal powder at the centre of a rotating mould having an enclosed cavity of the required irregular form, whereby the powder is thrown outwardly by centrifugal force to fill the mould working progressively from the outer periphery to the centre, then sintering the metal powder in the mould under suitable conditions of time, temperature and atmosphere to form a rigid plate.

3. The method according to Claim 1 or 2 in which the speed of rotation is sufficiently high to cause a different packing of the powder so as to produce a plate having a gradually increasing porosity towards the centre.

4. The method according to any of Claims 1, 2 or 3 in which the mould is vibrated axially during its rotation.

5. A mould for making porous metal plates according to the method claimed in Claim 1 or Claim 2, comprising two members fastenable together to form the cavity of the required shape, an aperture at the centre of one of the members through which the cavity can be filled, and means by which the mould can be attached to a rotatable support for rapid rotation.

6. A new article of manufacture comprising a sheet of porous metal of wave-like cross-section, made from sintered metal powder.

7. A new article of manufacture comprising a sheet of porous metal having a porosity greater at the centre than at the periphery and made from sintered metal powder.

8. The method of making porous metal plates of irregular cross-section substantially as hereinbefore described.

9. A porous metal plate made from sintered metal powder substantially as hereinbefore described.

Dated this 7th day of January, 1943.

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Agent for Applicants.

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[Wt. 8229A.—10/1946.]

FIG. 1.

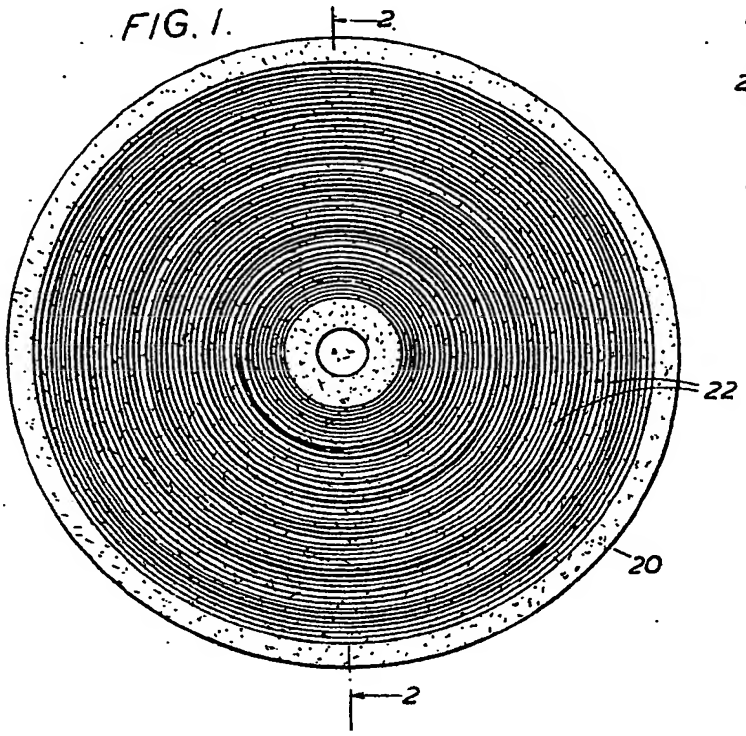

FIG. 2.

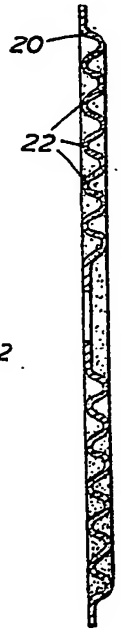

FIG. 3.

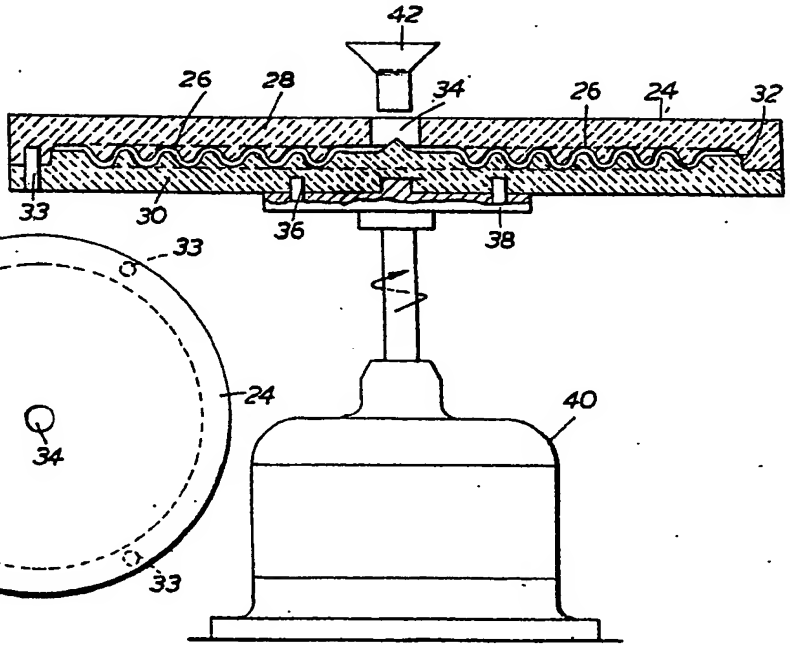

FIG. 4.

H.M.S.O. (Ty.P.)